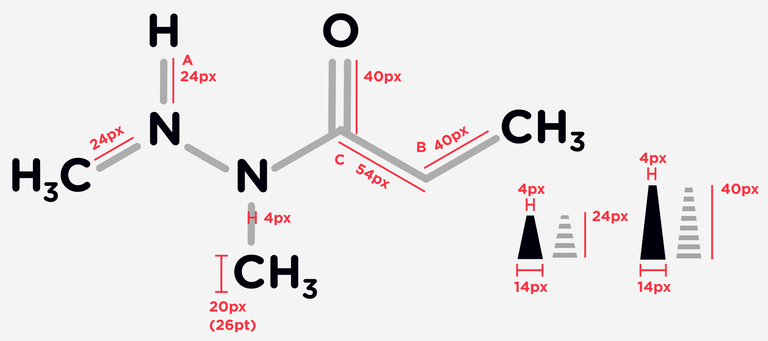
2D Atom & Bond visualization guide - Lewis Structures

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890—•

Font: Gotham Rounded Bold
Font color: 00000D
Font size: 26pt



Bond color: ADADAD
Bond width: 4px

Dash color: ADADAD
Wedge color: 00000D

Bond lengths (left):

A - two shown atoms: **24px**

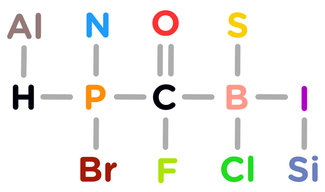
B - one shown atom linked to carbon chain: **40px**

C - two hidden carbons linked in carbon chain: **54px**

***Dashes and wedges will only adhere to bond types A & B**

Color modes

C	00000D	Br	A41904
H	00000D	I	AE00C5
N	1E9BFF	P	FF8D00
O	FF3232	B	FF988A
S	F8CF00	Al	947979
F	ABE405	Si	6B7FBE
Cl	21DC21	•••	FF51F1

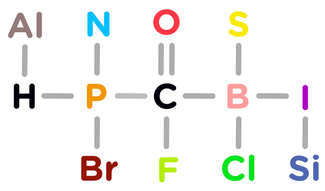


Substrate Default color palette

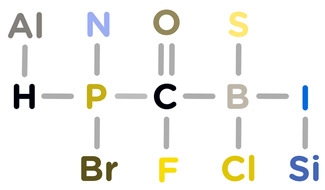
This color palette is based on the CPK system, but with adjusted colors to enhance user experience.
Use as a default.

C	00000D	Br	941400
H	00000D	I	AE00C5
N	00BFFE	P	F19600
O	FF3745	B	FF9D9D
S	F8EA00	Al	947979
F	B2EE00	Si	4E66B2
Cl	00E51C	•••	FF51F1

Normal vision:



Red-blind/Protanopia:

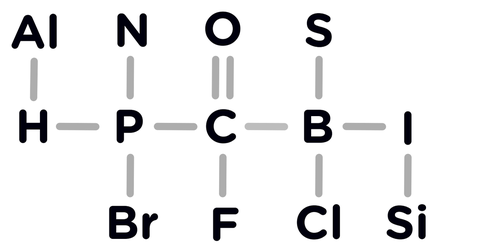


Substrate Color-blind palette

This color palette has been optimized for color-blind users. The affected atoms that have been changed from the default palette are underlined in black.

Resources:
https://www.color-blindness.com/coblis-color-blindness-simulator/

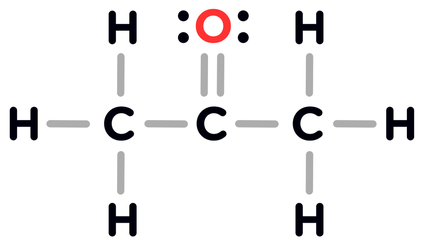
All 00000D



All Black

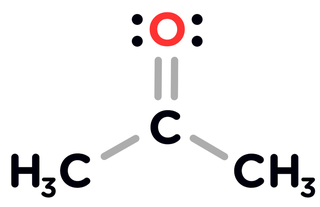
The all-black color mode applies the carbon color swatch (#00000D) to every atom.

Visualization styles



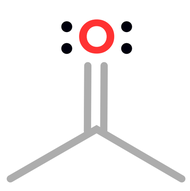
Lewis structures (expanded)

This is acetone visualized via a standard Lewis Structure, simple and grid-like, with every atom and bond shown. When students are asked to draw a Lewis Structure, use this visualization.



Condensed formula

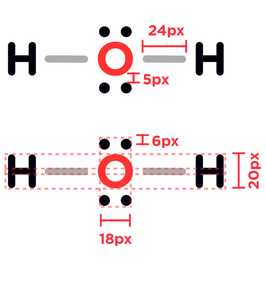
This is acetone visualized via the “condensed formula”, which takes hydrogens and reduces the bond visualization into texts and subscripts. Certain questions in the problem set may use this formula.



Skeletal structure or line structure

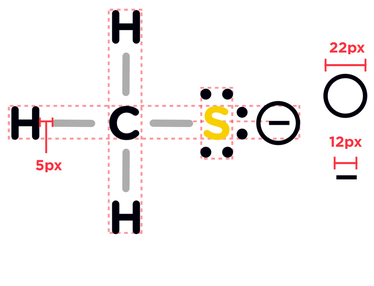
This is how acetone looks when represented by a line structure. Carbons and hydrogens are hidden unless they need to be shown because of an associated charge, etc. Heteroatoms, or any atoms that aren’t carbon or hydrogen, are always shown.

Lewis Structures



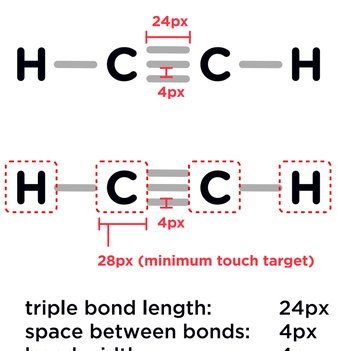
bond length: 24px
atom width: ~20px (varies by letter)

lone pairs
diameter: 6px
distance from atom: 5px
span width: 18px
color: 00000D



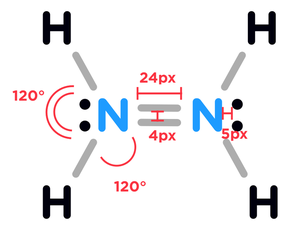
formal charge length: 12px
formal charge width: 3px
formal charge container width: 22px

distance between bond and atom: 5px
formal charge distance from atom: 5px



triple bond length: 24px
space between bonds: 4px
bond width: 4px
space between triple bonds: 4px

minimum button size target: 28px
(~18-20px atom width + ~5px on each side)

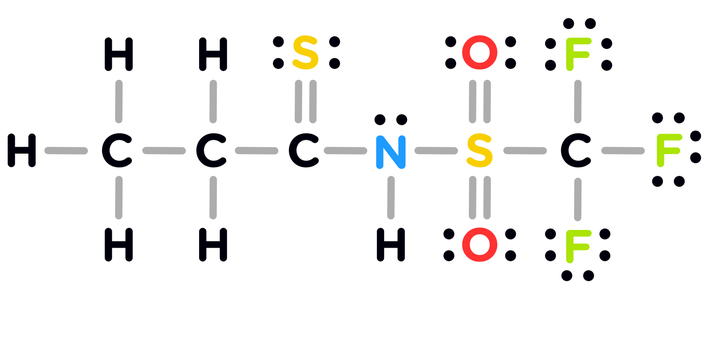


Hydrazine

distance between lone pair & atom: 5px
space between double bonds: 4px

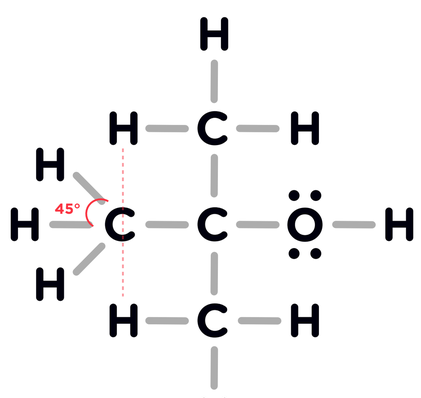
double bond length: 24px

bond angles: 120°
(see hydronium ion below)



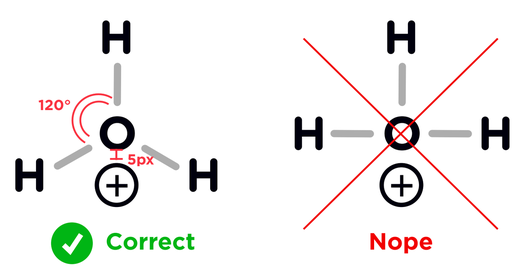
N-((trifluoromethyl)sulfonyl)propanethioamide

An example of a larger molecule visualized as a Lewis Structure. Every atom and bond is shown.



tert-Butanol

Here is an example of “crowding”. Some of the hydrogens are oriented in a way that disallows showing their normal structure in a methyl group, so it is necessary to orient them at 45° angles to their parent carbon to avoid overlapping with adjacent hydrogens.



Hydronium ion

Accurate bond angles should be represented when there are 3 consecutive carbons/ heteroatoms or less present.

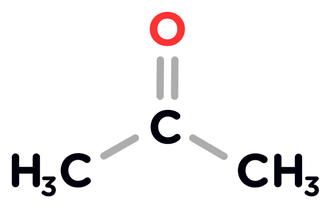
formal charge distance from atom: 5px

Notes

- Dimensions are for relative scale reference
- Bond width and text width match
- Space between atom boundary and bond boundary is ~5-6px and should be consistent throughout molecule
- Formal charge should align with the intersected centers of the lone pairs
- Center of subscript text height should be aligned with bottom of normal text

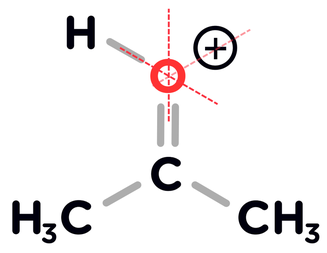
Condensed formula

The condensed formula takes hydrogens and reduces their atom and bond visualization into texts and subscripts. Certain questions in the problem set may use this formula.

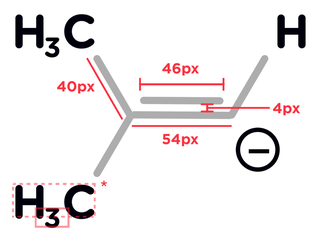


Condensed formula

Use the condensed formula when a molecule consists of 3-5 or less consecutive carbons and/or heteroatoms in a chain.

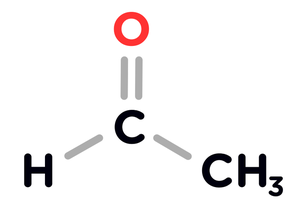


Bond angles should be accurate, and formal charge should be displayed at the midpoint of the continuation of the opposing bond angles.



carbon-methyl group bond length: 40px
carbon-carbon bond length: 54px
space between double bond: 4px
hidden carbon-carbon double bond length: 46px

*** subscript midpoint should align with bottom of normal text**



Notes

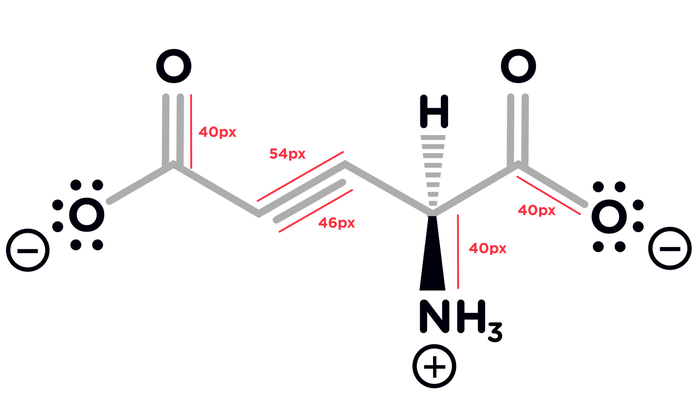
- Condensed formula can be used for longer molecules (up to 5 consecutive carbons/heteroatoms), but in most cases, skeletal structure should be prioritized

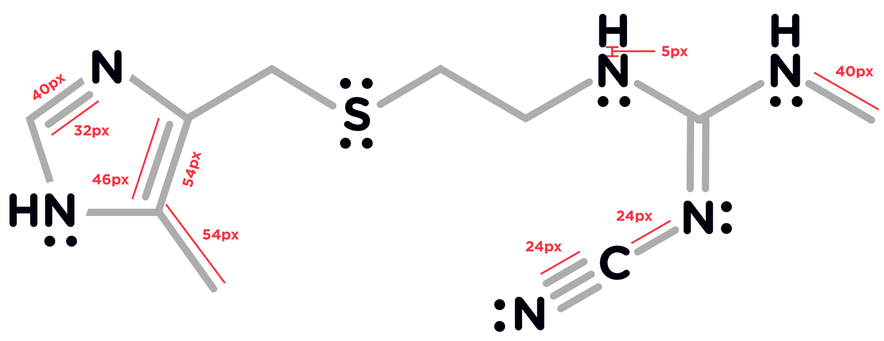
- Methyl groups take the color of carbon (#00000D)

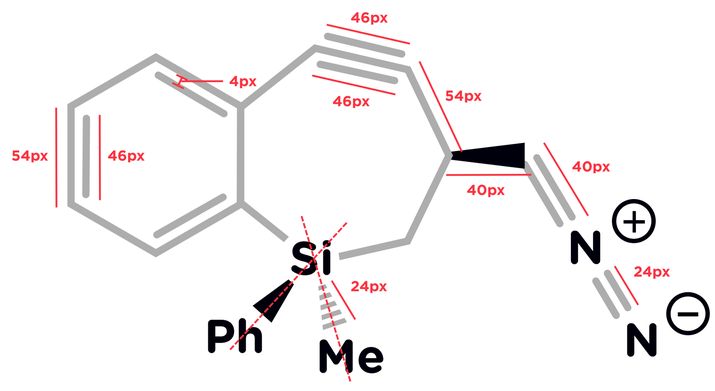
- The ends of the double bond adjacent to hidden carbon - carbon bonds are free

Skeletal/Line structure

The skeletal or line structure serves as a shorthand representation of a molecule's bonding and some details of its geometry. We should aim to follow many of the general conventions seen in this article: (https://en.wikipedia.org/wiki/Skeletal_formula), while using the styles given here.







heteroatom to C, H, or other heteroatom bond length: 24px

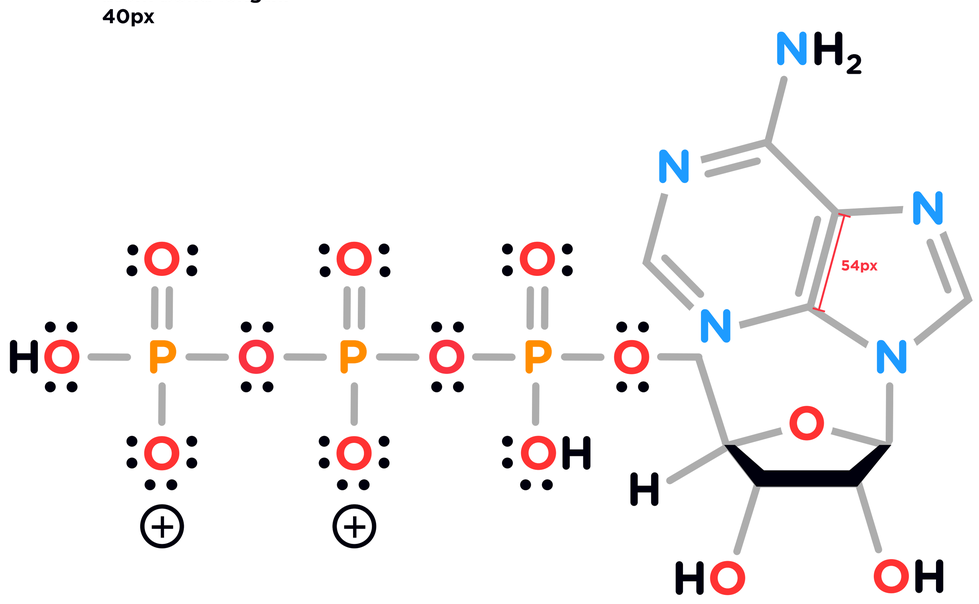
vertex (hidden carbon) to shown atom bond length: 40px

resonance double bond length (heteroatom): 32px
resonance double bond length: 46px

space between heteroatom and hydrogen: 5px

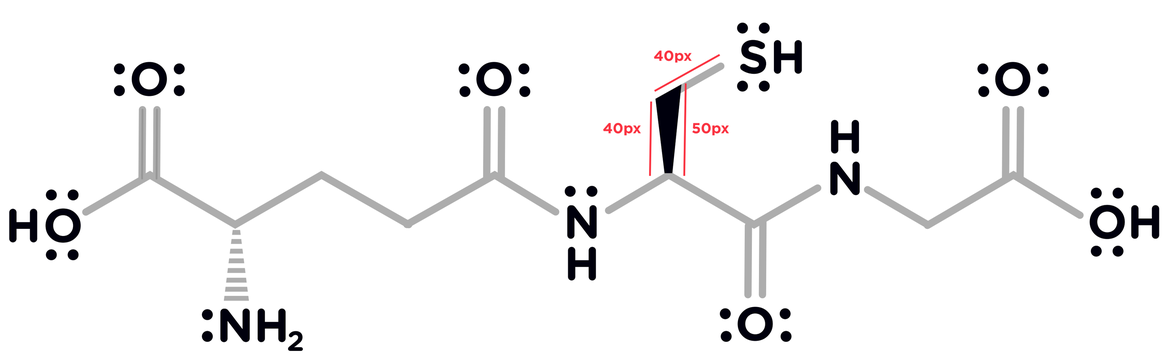
heteroatom to atom wedge/dash bond length: 24px
resonance double bond length: 46px
vertex to vertex (hidden carbon) bond length: 54px

space between all double bonds (resonance included): 4px



Adenosine triphosphate (ATP)

With this example, both skeletal structure and Lewis Structure formats are visualized. This may occur occasionally on an individual question basis.



Angled wedges:
To make a seamless transition in the case where a wedge is connected to a single bond, the wedge is extended upward at an angle to the side closest to the end of the bond. The wedge should sit on top of the bond.

Notes

- Dashes and wedges have two different sizes, 24px vs 40px lengths, depending on if they bond to a visible or hidden atom

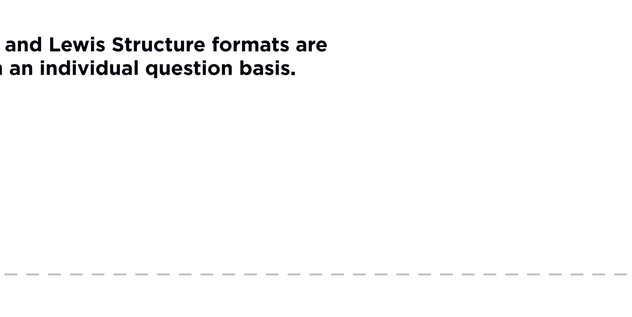
- Wedges are sometimes angled when laid over single bonds to create seamless intersections

- When depicting resonance/double or triple bonds inside of carbon rings or alongside skeletal vertexes, the length of the bond will will be shorter to avoid edge crowding

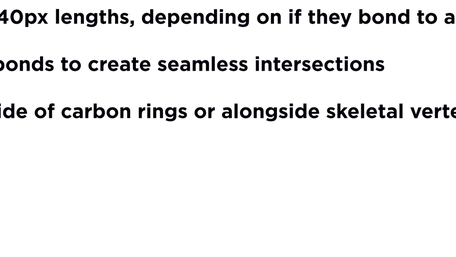
Scaling 2D structures

iPhone X actual size

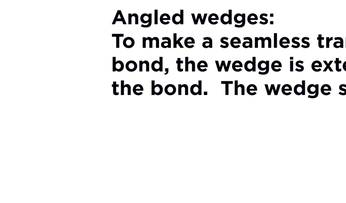
100%
bond width: 4px
font size: 26pt



75%
bond width: 3px
font size: 20pt



55%
bond width: 2.25px
font size: 14.5pt



42%
bond width: 2px
font size: 11pt

30%
bond width: 1.5px
font size: 8.25pt

Note: Don't render fonts smaller than 8pt

Notes

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- When depicting resonance/double or triple bonds inside of carbon rings or alongside skeletal vertexes, the length of the bond will will be shorter to avoid edge crowding